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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/726,328	12/01/2003	Garro J. Derderian	MI22-2297	3662

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EXAMINER

SUCH, MATTHEW W

ART UNIT	PAPER NUMBER
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2891

DATE MAILED: 11/21/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/726,328	Applicant(s) DERDERIAN ET AL.	
	Examiner Matthew W. Such	Art Unit 2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 September 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 32,33 and 36-50 is/are pending in the application.
- 4a) Of the above claim(s) 36-38,49 and 50 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 32,33 and 39-48 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 September 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>12/1/03 and 12/31/03</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Objections to the specification and drawings presented in the Office Action dated 26 June 2006 have been withdrawn on Applicant amendments.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 32-33, 39-40, 42-43, 45 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuba ('687) in view of Fukunaga ('104).

- a. Regarding claim 32, Matsuba teaches a method of forming a particle-impregnated conductive material over a substrate (Element 10, 16). Particles (Element 12, 19) are spread and dispersed by a spray technique (Para. 0051) over the substrate. A monolayer (Element 14, 21) is formed over the dispersed particles forming a conductive material and particles are at least part of the particle-impregnated conductive material. The manner in

which the claim is written does not limit the number of monolayers that can be formed over the particles.

Matsuba does not teach that the substrate is a semiconductor substrate. Fukunaga teaches a particle dispersion process over a semiconductor substrate. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a semiconductor substrate to form interconnect structures for devices (for example, Fukunaga Para. 0014-0015).

Matsuba teaches that the particles can be dispersed on the substrate by a spray process, but does not teach that the spray process also includes a liquid carrier and evaporating the liquid. Fukunaga teaches a spray process for dispersing particles over a substrate by mixing the particles with a liquid, spraying, and then evaporating the solvent (Para. 0092-0095). It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the spray process of Matsuba as taught by Fukunaga since the process is functionally equivalent for forming a coating of particles.

b. Regarding claims 33 and 39, Matsuba further teaches that the particles are electrically conductive since they can comprise aluminum, titanium, tantalum, tungsten, or nitrides thereof (Para. 0047, 0055).

c. Regarding claims 40, 42-43, 45 and 48, Matsuba further teaches that the monolayer can comprise tungsten, tantalum, or tungsten (Para. 0047, 0059). The

monolayer or particles can also comprise tantalum nitride (Para. 0047), meaning the particle –impregnated material can comprise tantalum nitride.

4. Claims 32-33, 44-45 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers ('387) in view of Hill ('577).

d. Regarding claim 32, Raaijmakers teaches a method for forming a particle-impregnated conductive material over a semiconductor substrate (Element 20, 32). Particles (Elements 48, 52, 304) are spread over the semiconductor substrate (Element 20, 32). A monolayer of conductive electrode material (Paragraphs 0100-0103, 0139-140; Elements 46, 310) is formed over the particles forming at least part of a particle-impregnated material (Fig. 3). The manner in which the claim is written does not limit the number of monolayers formed over the particles, nor the position relative to the particle location as long as they are over, nor the length of time the monolayer remains.

Raaijmakers does not teach that the particles can be formed by providing a mixture with a liquid carrier and evaporating the liquid carrier to leave particles dispersed over a substrate. Hill teaches a method of forming particles for capacitor devices such as those described by Raaijmakers. Hill further teaches that the particles can be formed by providing a mixture with a liquid carrier and evaporating the liquid carrier to leave particles dispersed over a substrate, using an aerosol process (Para. 0030). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form

the particles of Raaijmakers using an aerosol process since the process yields several layers of particles instead of just the one of Raaijmakers, increasing the surface area and capacitance for the storage cell (Hill Para. 0039; Figures).

e. Regarding claim 33, Raaijmakers further teaches that the particles (Elements 48, 52, 304) are an electrically conductive electrode (Paragraph 0012, 0088).

f. Regarding claim 44, Raaijmakers further teaches that the particles have a size of about 50-750 Angstroms (5-75 nanometers), which is within the claimed range of 100-10,000 Angstroms (Paragraph 0012).

g. Regarding claim 45, Raaijmakers further teaches that the monolayer comprises tungsten (Paragraph 0139-140).

h. Regarding claim 48, Raaijmakers teaches that the monolayer comprises tantalum (Paragraphs 0100-0103).

i. Claims 39-42 and 46-47 rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers ('387) in view of Hill ('577) as applied to claim 32 above, and further in view of Lee (824).

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j. Regarding claim 39, Raaijmakers / Hill teaches using silicon as the particles in capacitor structures (Paragraph 0010 and 0012). Raaijmakers / Hill teaches that silicon nitride is used as a barrier layer protecting the silicon particles from oxidation, but admits that the silicon nitride layer is incorporated into the dielectric, lowering the effective dielectric constant. Raaijmakers / Hill does not teach using tungsten for the particles.

Lee teaches that the particles comprise tungsten (Col. 5, Lines 45-48). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use tungsten as the particles as taught by Lee in the methods of Raaijmakers / Hill in order to maintain a high dielectric constant in dielectric film (Lee Col. 5, Lines 49-52). Lee teaches that a refractory metal such as tungsten can be used as particles to avoid nitridation of the dielectric layers and maintain a higher dielectric constant (Col. 3, Lines 25-41).

k. Regarding claim 40, Raaijmakers further teaches that the monolayer comprises tungsten (Paragraph 0139-140).

l. Regarding claim 41, Raaijmakers teaches using silicon as the particles in capacitor structures (Paragraph 0010 and 0012). Raaijmakers teaches that silicon nitride is used as a barrier layer protecting the silicon particles from oxidation, but admits that the silicon nitride layer is incorporated into the dielectric, lowering the effective dielectric constant. Raaijmakers / Hill does not teach using tungsten for the particles.

Lee teaches that the particles comprise tungsten silicide (Col. 5, Lines 45-48). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use tungsten as the particles as taught by Lee in the methods of Raaijmakers in order to maintain a high dielectric constant in dielectric film (Lee Col. 5, Lines 49-52). Lee teaches that a refractory metal silicide such as tungsten silicide can be used as particles to avoid nitridation of the dielectric layers and maintain a higher dielectric constant (Col. 3, Lines 25-41).

m. Regarding claim 42, Raaijmakers further teaches that the monolayer comprises tantalum (Paragraphs 0100-0103).

n. Regarding claim 46, Raaijmakers teaches that the monolayer comprises tungsten (Paragraph 0139-140). Raaijmakers also teaches that monolayer metals, can be exposed to a silane to incorporate silicon in the layer (Paragraphs 0064-0069). Raaijmakers / Hill does not forming tungsten silicide.

Lee teaches using metal silicides, such as tungsten silicide as an upper electrode along with using SiH_4 , Si_2H_6 , and SiH_2F source gases during deposition. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a metal silicide, such as tungsten silicide, as taught by Lee in place of the tungsten used by Raaijmakers. Tungsten and tungsten silicide are functionally equivalent in terms of an ability to act as diffusion barriers to keep, for example, silicon out of the dielectric and prevent dielectric degradation of the capacitor system during processing (Lee Col. 7,

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Lines 45-56). It has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice.

The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v.*

Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

o. Regarding claim 47, Raaijmakers further teaches forming a tungsten monolayer with WF₆ (Paragraph 0140).

5. Claim 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers ('387) in view of Hill ('577) in view of Lee ('824) as applied to claim 42 above, and further in view of Kim ('487).

Raaijmakers / Hill / Lee teach that the monolayer comprises tantalum (Raaijmakers Paragraphs 0100-0103; Lee Col. 7, Lines 32-44). More specifically, the tantalum comprising film can be a Ta₂O₅ dielectric film. Although Raaijmakers / Hill / Lee teach various alternatives to Ta₂O₅, neither explicitly discloses tantalum nitride.

Kim teaches using a tantalum comprising monolayer, such as Ta₂O₅, as a dielectric material. Kim teaches a variety of alternative materials for the monolayer, such as tantalum nitride (Col. 8, Lines 26-39).

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to use tantalum nitride as the monolayer as suggested by Kim in the methods described by Raaijmakers / Hill / Lee. Lee teaches that tantalum nitride is functionally equivalent to Ta₂O₅ in terms of dielectric properties. It has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice.

The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

Response to Arguments

6. Applicant's arguments with respect to claims 32-48 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Fukunaga ('596) teaches methods of forming interconnect structures with particles dispersed from solution.

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8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew W. Such whose telephone number is 571-272-8895. The examiner can normally be reached on Monday - Friday 8AM-5PM EST.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bradley W. Baumeister can be reached on 571-272-1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew W. Such
Examiner
Art Unit 2891

MWS
11/15/06



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